0010-1098-0

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF: :

YASUAKI SEKI ET AL : EXAMINER: PATEL

SERIAL NO.: 09/539,864 :

FILED: MARCH 31, 2000 : GROUP ART UNIT: 2841

FOR: INSULATING RESIN COMPOSITION FOR MULTILAYER PRINTED-WIRING BOARD

AMENDMENT AND REQUEST FOR RECONSIDERATION

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Responsive to the Official Action dated November 7, 2001, Applicants respectfully request reconsideration of the above-identified application in view of the following amendments and remarks.

IN THE CLAIMS

Please amend the claims as shown on the attached marked-up copy to read as follows:

Please cancel Claims 3-10, without prejudice toward the further prosecution of these claims in a Continuation and/or Divisional Application.

Please amend the claims as follows:

--20. (Amended) The [method] multilayer printed-wiring board of Claim 19, wherein said plasma-treated insulating layer has a surface roughness of 100 nm to 4,000 nm.--

Please add the following new claims:

--23. (New) The multilayer printed-wiring board of Claim 19, wherein said insulating layer comprises a resin selected from the group consisting of polyamide resins; epoxy resins; cyanate ester resins; polyether sulfone resins; polyphenylene ether resins; diallyl phthalate resins; polyurethane resins; polyester resins; phenolic resins; phenoxy resins; resins obtained by polymerizing two or more monomers selected from the group consisting of butadiene, acrylonitirle, styrene, and (meth)acrylate; and mixtures thereof.

24. (New) The multilayer printed-wiring board of Claim 19, wherein said insulating layer is formed on a surface of a substrate and said substrate comprises a wiring pattern on said surface of said substrate.

25. (New) The multilayer printed-wiring board of Claim 24, wherein said process further comprises forming holes in said insulating layer to expose a portion of said wiring pattern.

26. (New) The multilayer printed-wiring board of Claim 19, wherein said plasma etching is reactive ion etching and with argon gas as an etching gas.--

SUPPORT FOR THE AMENDMENTS

Applicants have canceled Claims 3-10 and added new Claims 23-26. Support for new Claims 23-26 can be found in previously-filed Claims 13, 17, 18, and 16, respectively. Applicants have also corrected the dependency of Claim 20. Accordingly, support for Claim 20 can be found in the same claim as previously filed

No new matter has been added. Claims 11-26 are pending in this application.

REMARKS

Present Claims 11-18 relate to a method for producing a multilayer printed-wiring board, comprising:

(1) plasma etching a layer of an insulating resin composition, to obtain a plasma-treated insulating layer; and

(2) forming a conducting layer on said plasma-treated insulating layer,

wherein said resin composition comprises a first resin and a second resin, and said first resin and said second resin have different plasma etching rates and said first resin and said second resin are not compatible with each other.

Present Claims 19-26 relate to multilayer printed-wiring boards prepared by such a method.

A problem to be solved by the present invention may be described as how to ensure or improve the bonding strength between an insulating layer and the adjacent conducting layer(s) in a multilayer printed-wiring board, while at the same time ensuring the heat resistance and electrically insulating properties required. According to the present invention, this problem has been solved by: (i) using, as the insulating layer, an insulating resin composition which comprises at least two kinds of resins which are not compatible with each other and which exhibit different plasma etching rates; and (ii) rendering the surface of the resulting insulating layer uneven by plasma treatment prior to forming a conductor layer(s) thereon (see, *e.g.*,the Abstract, on page 28 of the instant specification). The inventors have discovered that the multilayer printed-wiring boards prepared by the methods of present Claims 11-18 and the multilayer printed-wiring boards of Claims 18-26 exhibit an enhanced bonding between the insulating layer and the conducting layer.

The cited references contain no disclosure which would suggest the presently claimed

methods or multilayer printed-wiring boards. In particular, these references, even in combination, contain no teaching which would remotely suggest the improved adhesion properties exhibited by the presently claimed multilayer printed-wiring boards. Accordingly, these references cannot affect the patentability of the present claims.

The rejection of Claims 19-22 under 35 U.S.C. §103(a) in view of U.S. Patent No. 6,121,553 (Shinada et al) in view of U.S. Patent No. 6,042,929 (Burke et al) and U.S. Patent No. 6,040,068 (Yasumoto et al) is respectfully traversed.

Shinada et al discloses insulating adhesive layers made from a thermosetting adhesive composition comprising a polyamide-imide resin and a thermosetting component as exemplified by an epoxy resin. However, Shinada et al is completely unconcerned with the use of plasma etching to roughen the surface of an insulating layer or the enhanced bonding between the insulating layer and a conducting layer afforded by such surface roughening of the insulating layer. In fact, it does not appear that the insulating adhesive layers of Shinada et al are even insulating layers on which a conductor layer is to be formed (as recited by the present claims). Thus, Shinada et al is not even concerned with the problem of ensuring the bonding strength between an insulating adhesive layer and a conductor layer, and there is nothing in this reference which would remotely suggest the use of plasma-etching to strengthen any bonding.

In contrast, the present claims explicitly recite:

"(1) plasma etching a layer of an insulating resin composition, to obtain a plasma-treated insulating layer; and

(2) forming a conducting layer on said plasma-treated insulating layer."

Neither Burke et al nor Yasumoto et al provide any teaching which can cure the basic deficiencies of Shinada et al. Thus, although the invention in Burke et al relates to polymer

film metal composites useful for making printed circuits which are resistant to delamination, particularly when exposed to high temperature and/or humidity (see, column 1, lines 7-10), the method and products disclosed in Burke et al are entirely different from those presently claimed. Quite simply, Burke et al contains no disclosure or suggestion of using an insulating resin composition, which comprises "a first resin and a second resin, and said first resin and said second resin have different plasma etching rates and said first resin and said second resin are not compatible with each other," as recited in the present claims.

In contrast, the method and products of Burke et al require the use/presence of two-extra specific layers between a polymeric substrate (made of polyamide alone, for example) having at least one surface modified by plasma etching to form a micro-roughened substrate surface and a (third) electrically conductive metal layer (on said nonstoichiometric metal nitride layer), the two extra specific layers being a first metal nitride layer on said micro-roughened substrate surface and a second nonstoichiometric metal nitride layer on said first metal nitride layer (see, e.g., Claim 1 of Burke et al). In contrast, the presently claimed methods and multilayer printed-wiring boards do not require any such two extra specific layers.

Yasumoto et al is not even concerned with etching of "a layer of an insulating resin composition," as recited by the present claims. Instead, Yasumoto et al discloses that a "metallized layer is plasma-etched." Moreover, this reference contains no disclosure or suggestion of "plasma etching a layer of an insulating resin composition," which comprises "a first resin and a second resin, and said first resin and said second resin have different plasma etching rates and said first resin and said second resin are not compatible with each other."

In summary, none of the cited references contain any disclosure or suggestion of "plasma etching a layer of an insulating resin composition," which comprises "a first resin

and a second resin, and said first resin and said second resin have different plasma etching rates and said first resin and said second resin are not compatible with each other." Moreover, none of these references contain any teaching which would suggest any advantage or improvement to be obtained by multilayer printed-wiring boards so produced.

In contrast, the present claims all recite the step of "plasma etching" of the insulating resin composition and that the resin composition comprises "a first resin and a second resin, and said first resin and said second resin have different plasma etching rates and said first resin and said second resin are not compatible with each other." As described under the "Means to Solve the Problems" section bridging pages 6 and 7 of the present specification, the gist of the present invention lies in the facts:

> The present inventors have conducted made extensive and intensive studies with a view to solving the above-mentioned problems. As a result, it has been found that the below-described resin composition has extremely excellent performance, on the basis of which the present invention has been completed.
>
> Specifically, the present invention relates to an insulating resin composition for a multilayer printed-wiring board which composition is to be used to form, or as, an insulating layer of the multilayer printed-wiring board, wherein for obtaining a roughness or unevenness by plasma treatment on the surface of the insulating layer resulting from the insulating resin composition, the said insulating resin composition comprises two or more kinds of resins which are different in etching rate by a plasma treatment and which are not compatible with each other.
>
> Thus, it has become possible to perform fine roughness formation treatment on the surface of the insulating layer by a dry treatment, such as a plasma treatment or the like. In this case, it is preferred that a surface roughness degree of the above-mentioned insulating layer by the plasma treatment is adjusted so as to be in the range of 100 to 4,000 nm.

Specification, pp. 6-7 (Emphasis added).

The benefits obtained by the presently claimed methods are described in the "Problems to be Solved by the Invention" section on page 6 of the present specification and the "Effect of the Invention" section bridging pages 25 and 26 thereof:

> [Problems to be Solved by the Invention]
>
> The present invention has been made for solving the above-mentioned problems effectively, and it is an object to provide an insulating resin composition for a multilayer printed-wiring board, which can ensure the bonding strength of a conductor layer with an insulating layer by performing a rough surface formation by a dry treatment, such as plasma or sputtering or the like, without performing a wet treatment which has conventionally been conducted for the rough surface formation, and can satisfy heat resistance and electrically insulating properties.
>
> Specification, p. 6 (Emphasis added).
>
> * * *
>
> [Effect of the Invention]
>
> As mentioned above, according to the insulating resin composition for a multilayer printed-wiring board of the present invention, the following excellent effects can be exhibited.
>
> In the formation of the rough surface on the insulating layer for ensuring a satisfactory bonding force between the conductor layer and the insulating layer, not a wet treatment using an oxidant or the like which has been conventionally conducted but a dry treatment having high productivity, such as a plasma treatment or the like, can be employed. Thus, a stable form of a rough surface can be obtained without the conventional problems about cumbersome bath control and waste liquid treatment, and a high bonding strength can be realized. Further, by using this insulating resin composition, both of high heat resistance and excellent electrical properties can be achieved, and a multilayer printed-wiring board having a high wiring density can be produced.
>
> Specification, pp. 25-26 (Emphasis added).

As compared with the presently claimed invention discussed above, Shinada et al

indeed disclose use of a resin composition including two finds of resins which are not compatible with each other as an insulating layer. However, this reference does not disclose or suggest any roughening by a plasma treatment. In other words, the method of Shinada et al stops at a point where the resin composition is only used as an insulating layer, and does not go any further. Although Burke et al and Yasumoto et al disclose plasma etching, there is no teaching in either of these references which would suggest using a resin composition which comprises "a first resin and a second resin, and said first resin and said second resin have different plasma etching rates and said first resin and said second resin are not compatible with each other."

Moreover, as noted above, it does not appear that the insulating adhesive layers of Shinada et al are even insulating layers on which a conductor layer is to be formed (as recited by the present claims) or that Shinada et al is even concerned with the problem of ensuring the bonding strength between an insulating adhesive layer and a conductor layer. Thus, there is nothing in Shinada et al which would remotely suggest the use of plasma-etching to strengthen any bonding, and the skilled artisan would not be motivated to apply the etching step of either Burke et al or Yasumoto et al to Shinada et al.

For all of these reasons, the rejection is improper and should be withdrawn.

Furthermore, even the combined teachings of the cited references fail to suggest any advantage to be obtained by the presently claimed multilayer printed-wiring boards. In contrast, as noted above, the present inventors have discovered that the presently claimed multilayer printed-wiring boards exhibit dramatic and unexpected improvements in adhesion properties as compared to multilayer printed-wiring boards produced by a different process.

Thus, according to the present invention, a first resin, *e.g.*, a thermoplastic polyimide resin such as "Ultem" or "SN-20" is blended with a second resin, *e.g.*, an epoxy resin

"EP1001" which is not compatible with the first resin (e.g., "Ultem" or "SN-20a") and which has a different plasma etching rate than "Ultem" or "SN-20" to obtain an insulating resin composition used to form an insulating layer whose surface may be roughened or modified by plasma-etching, as disclosed in Examples 1 and 2 of the present specification. In this regard, it should be noted that "Ultem," more accurately "Ultem 1000," is referred to as Sample No. 7 in TABLE X of Burke et al.

When the resulting insulating layer made from such an insulating resin composition is then subjected to surface-roughening treatment by plasma etching, a conducting layer (*e.g.*, copper film) formed on the roughened surface of the insulating layer, *e.g.*, by sputtering, followed by electroplating, is tightly and stably bonded to the insulating layer, as can be seen from the results of measurement of "Blister after annealing," "Peel strength," and "Solder heat resistance," as given in Table 2, on page 24, for Examples 1 and 2 of the present specification. Moreover, as can be seen from the results of measurement of "Blister after annealing," "Peel strength," and "Solder heat resistance," as given in Table 2, on page 24, for Comparative Examples 1 and 2 (which use compatible, rather than incompatible, first and second resins) of the instant specification, the results are very poor, as compared with those of Examples 1 to 3.

There is no teaching in any of the cited references which would suggest the dramatic improvements exhibited by the samples according to the present claims. Accordingly, these improvements ensure the patentability of the present claims.

In further support of the unobvious nature of the presently claimed methods and multilayer printed-wiring boards, Applicants cite the data and results presented in the Declaration under 37 C.F.R. § 1.132 of Kouichirou Sagawa ("Declaration of Sagawa") being filed herewith. In the Declaration of Sagawa, results are presented for new Comparative

Examples 3 and 4, which were prepared in a similar fashion as original Comparative Examples 1 and 2, with the exception that the insulating layer was made of a single insulating resin (i.e., "Ultem" or "SN-20") has been used, rather than a mixture of two or more kinds of insulating resins.

For convenience, the results of Comparative Example 3 and 4, from the Declaration of Sagawa, and the results for Examples 1-3 of the present specification are presented side-by-side below:

Composition	Example No.			Comparative Example No.	
	1	2	3	3	4
Ultem	70		70	100	
SN-20		70			100
EP-1001	30	30			
B-30			30		
YP-50S					
2E4MZ	0.9	0.9			
Tin Octylate			0.006		
Surface of roughening plasma treatment	O	O	O	X	X
Blister after annealing	O	O	O	X	X
Peel strength (kg/cm)	1.2	1.0	1.0	0.2	0.3
Solder heat resistance (260 °C, 30 sec)	O	O	O	X	X

As stated in the Declaration of Sagawa, the improved properties exhibited by the

samples of Examples 1-3 could not have been expected based on the teachings in the prior art. Moreover, these improvements are significant and important. Accordingly, these results ensure the patentability of the present claims.

Thus, the rejection should be withdrawn.

The rejection of Claim 20 under 35 U.S.C. § 112, second paragraph, has been obviated by appropriate amendment. As the Examiner will note, Applicants have amended Claim 20 such that it is free of the criticism outline on page 2 of the Official Action. Accordingly, the objection is no longer tenable and should be withdrawn.

Applicants note the fact that the Examiner has held Claims 11-18 withdrawn as being directed to a non-elected invention. However, Applicants submit that the restriction between Claims 11-18 and 19-26 is improper for the following reason. Claims 19-26 and 11-18 are related as product and process of making. Inventions so related are distinct, if the product, ***as claimed***, can be made by a materially different process or if the process, as claimed, can be used to make a materially different product.

On page 2 of the Official Action, it is asserted that the "product as claimed can be made by a different plasma etching process than reactive ion etching and with etching gas." However, Claim 11 does not require or recite "reactive ion etching and with etching gas." In fact, the product of Claim 19 is required to be prepared by precisely the same process recited in Claim 11. Accordingly, the restriction is improper and should be withdrawn.

In any event, since product Claims 19-26 are now allowable and since process Claims 11-18 contain all the limitations of product Claim 19, process Claims 11-18 should now be rejoined pursuant to MPEP §821.04.

Applicants submit that the application is now in condition for allowance, and early notification of such action is earnestly solicited.

Respectfully submitted,

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